

Factors Associated With Pedestrian-Vehicle Collision Injuries and Fatalities

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Data from Washington State police records of pedestrian-vehicle collisions were used to tabulate injury and fatality rates for 1981 to 1983 and to investigate event characteristics associated with the occurrence of fatalities. Case-fatality rates are seen to be relatively higher when there is decreased visibility due to fog, lack of lighting or dark color of pedestrian clothing. Fatality rates from death certificate data for the same time period were compared with the police-reported rates. For children younger than 5 years, fewer cases of pedestrian death are reported by police than by death certificate, because a large proportion of fatal injuries (27%) is not traffic related or occurs at home (46%) in the garage or driveway.

(Mueller BA, Rivara FP, Bergman AB: Factors associated with pedestrian-vehicle collision injuries and fatalities. *West J Med* 1987 Feb; 146:243-245)

More than 8,000 people die each year in the United States as a result of pedestrian-motor vehicle collisions. In urban areas, pedestrian injuries are the most common cause of injury death among children 5 to 9 years of age.¹ Prevention strategies relying on behavior change have had, at best, only modest success.²⁻⁵ Environmental factors, however, including aspects of vehicle design^{6,7} and road and signal construction,^{8,9} have been shown to have an impact on injury occurrence. There is a need for studies that examine other factors in the environment which may decrease the toll of pedestrian injuries and fatalities.

The purpose of the present analysis is threefold:

1. To measure the magnitude of this problem in Washington State by tabulating injury and fatality rates as derived from two sources—police records and death certificates.
2. To identify environmental factors associated with increased case-fatality rates by using the collision-incident information collected in police reports.
3. To compare these police-reported fatality rates with those derived from death certificate data from the same time period to investigate the nature of underreporting in police data.

Methods

In the present study we used data from two sources for the three-year period from 1981 to 1983. Washington State Department of Transportation records of all police-reported motor vehicle collisions where there was pedestrian involvement were used to compute annual injury and death rates and to evaluate various event characteristics with respect to the occurrence of pedestrian-vehicle incidents (PVI). Reporting of all motor vehicle collisions by state and local police and sheriff's departments is required by the Department of Transportation; therefore, these data (and similar data from other states) are frequently used as a population-based indicator of

motor vehicle-related injury occurrence. The second source of the data was the Department of Vital Statistics death certificate file containing the records of all deaths in Washington State coded with *International Classification of Diseases* ICD-E codes 814 to 825 (pedestrian-vehicle deaths). Death certificate data were assumed to be the best available indicator that a PVI-related death had occurred and were used as the standard against which police-reported PVI fatalities were compared. Underreporting of motor vehicle injuries by police data has previously been shown.^{10,11} Our concern in the present study was to compare these two sources in an effort to identify subgroups where systematic underreporting of pedestrian-vehicle injuries may be a problem.

To allow comparison of death rates computed from these two sources, the data were restricted to those fatal PVIs occurring in Washington State during 1981 to 1983 to a Washington State resident only. Persons with records in the death certificate data who died of injuries due to a PVI that occurred in another state and who were brought to Washington for hospital care were not included. Average annual injury and death rates were computed using the 1980 US census figures for the state as denominator and assuming a stable population base during the study period.

Results

A total of 5,065 pedestrian-vehicle collisions involving Washington residents were reported by police during the three-year interval from 1981 to 1983 in which 5,248 pedestrians were involved. PVIs in which more than one pedestrian was injured were less than 4% of the total. The number of pedestrian-vehicle collisions is compared in Table 1 with the number of nonpedestrian-motor vehicle collisions occurring during the same interval. PVIs are a less frequent but much more lethal occurrence as indicated by comparing the proportion of fatal events for PVIs (6%) to that for motor vehicle

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This study was funded by Contract No. 2620-44866 with the Washington State Department of Social and Health Services, Section of Emergency Medical Services.

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collisions in which a pedestrian was not involved (0.6%). In addition, virtually all PVIs reported involved an injury, whereas less than 40% of the other motor vehicle collisions involved a reported injury.

The annual rate of police-reported PVI injuries was 40.0 per 100,000 population (Table 2). The annual death rate using these data is 2.4 per 100,000. Age-specific rates vary greatly. Children and adolescents 19 years of age and younger were seen to be at highest risk of pedestrian injury, while the elderly and the very young are at greatest risk for dying. The case-fatality rate is high for young children, decreases for children 5 to 14 years of age and then rises again for children older than 15 years, a finding that is unexplained, as children in these age groups should be better able to survive trauma than those in the older age groups.

Using death certificate data, it was possible to compare the risks of pedestrian fatality among different racial groups. Most nonwhite groups were found to have higher death rates due to PVI than did whites. No PVI fatalities were seen for Asian groups including Japanese, Chinese, Korean, Asian Indian, Vietnamese and Hawaiian. Death rates per 100,000 population for other racial groups were 2.4 for whites, 3.8 for blacks, 5.6 for "other" and 14.8 for Native Americans (including American Indian, Aleut and Eskimo).

Selected event characteristics and location of PVI were evaluated using Department of Transportation data (Table 3). Limited visibility due to fog or lack of streetlights was associated with an increased case-fatality rate to a greater extent than were adverse road conditions due to snow and ice. That pedestrian visibility is a key factor is also shown by the lower case-fatality rate seen when light or bright colors were worn by the pedestrian. The location of a pedestrian when struck was also examined. Approximately a third of all pedestrians were injured while in marked crosswalks.

Events were coded in the Department of Transportation data as having occurred in an urban area if they were either in or adjacent to a municipality of at least 5,000 population. Using this classification, 624 of the total 5,248 pedestrians, or 12%, were injured in rural areas. The case-fatality rate for rural pedestrians, however, at 14.3% was much higher than that of 4.4% for urban pedestrians.

Although the death rates calculated using Department of Transportation data are generally similar to those from death certificate data (Table 2), deaths to children younger than 5 years appear to be underreported in the police data. Death rates from death certificate data indicate that the very young are at higher risk for pedestrian injury fatality than any other age group, with the exception of the elderly. Analysis of the death certificate data indicates that fatal pedestrian-vehicle injuries to children younger than 5 years may differ from those to older children and adults. A large proportion (46%) of these deaths to children younger than 5 occurs at home, presumably in the driveway or garage, and 27% are coded with the ICD-9 codes for nontraffic pedestrian-vehicle collision as cause of death.

Discussion

Underreporting of nonfatal motor vehicle injuries by police records has previously been shown.¹¹ In the present analysis, we find that, even for fatal injuries, police reports are incomplete, and we have determined the nature of the underreporting and an age group where underreporting is most common. Studies of pedestrian injuries that rely exclusively

on police-reported data are likely to systematically exclude nontraffic incidents occurring in driveways, garages or apartment building parking areas where the victim is younger than 5 years.^{12,13} Most of the nontraffic fatalities that occurred in Washington during the study period (59%) were to children younger than 5 years. Of all fatalities that occurred at home, 68% were to this age group. This suggests that a different focus is necessary to bring about a reduction in pedestrian fatalities to young children, requiring environmental changes in the home as well as on the street.

TABLE 1.—*Injury and Fatal Pedestrian-Vehicle and Other Motor Vehicle Collisions in Washington State—1981-1983**

Collision Category	Collisions 1981-1983, No.	Nonfatal Injury, %	Fatal, %
Pedestrian	5,065	93.9	6.0
Nonpedestrian†	314,169	36.7	0.6
All motor vehicles	319,234	37.6	0.7

*Source: Data Summary and Analysis of 1983 Traffic Collisions Washington State, US Department of Transportation.
†Includes 10,857 motorcycles and 3,369 pedalcycle collisions.

TABLE 2.—*Average Annual Age-Specific Pedestrian-Vehicle Injury and Death Rates* in Washington State—1981-1983*

Age Group, Yr	Police Reported†			Death Certificate Deaths
	Injuries	Deaths	Case-Fatality Rate, %	
< 5	25.6	1.5	5.6	4.0
5-9	76.4	2.3	2.9	2.6
10-14	65.0	1.6	2.3	1.8
15-19	53.6	3.2	5.6	2.7
20-24	39.6	2.1	5.0	2.1
25-29	32.7	1.7	5.0	1.7
30-44	26.1	1.8	6.4	1.9
45-64	20.9	1.8	8.1	2.1
65+	37.8	5.9	12.9	6.6
All ages	40.0	2.4	5.6	2.7

*Per 100,000 population based on 1980 US census figures.
†Washington State Department of Transportation.

TABLE 3.—*Police-Reported Fatal Pedestrian-Vehicle Incidents by Selected Event Characteristics, N = 5,248*

Characteristics	Injuries, No.	Fatal, %
Road surface		
Dry	3,621	5.7
Wet	1,471	5.4
Snow	81	4.9
Ice	75	4.0
Visibility-weather*		
Clear	4,011	5.7
Rain	1,109	5.1
Snow	74	2.7
Fog	52	7.7
Visibility-light		
Daylight	3,123	3.2
Dawn/dusk	225	4.9
Dark and streetlights	1,367	6.9
Dark—no streetlights	533	16.7
Pedestrian clothing color†		
Light/reflective color	798	3.4
Mixed colors	2,148	5.4
Dark color(s)	1,613	8.2

*Weather unknown for 2 cases.
†Clothing color unknown for 689 cases.

The rate of injuries and the case-fatality rates varied substantially with a number of factors. High rates of pedestrian injury for the very young and the elderly have been noted in previous studies.¹⁴⁻¹⁶ The high case-fatality rates seen here for adolescents and young adults, however, have not been previously commented on. Biologically, the adolescent and young adult populations overall have the greatest capacity to survive trauma, compared with any other age group.^{17,18} The limitations of the data do not allow us to determine if the injuries in this group are more severe or if other factors are at work to increase their risk of a fatal outcome. Increased alcohol use in this age group may be a factor; it is unclear, however, whether or not alcohol intoxication is associated with increased mortality from motor vehicle injuries.^{19,20} Data limitations precluded our analysis of alcohol use among the pedestrians. The increased case-fatality rate in young adults seen here warrants further study.

The differences in race-specific pedestrian fatality rates were also pronounced. The absence of deaths in Asians is surprising, given the fact that they constitute 4% of the population in the state. Previous work has indicated that most Asian groups have relatively lower unintentional injury rates than other racial groups.¹ The possibility of miscoding of race in the data, however, cannot be ruled out.

The striking increase in fatal outcome for pedestrians injured in rural areas compared with urban areas has also been noted by others¹ and has usually been ascribed to faster speeds of motor vehicles on rural roads. Other factors that might increase the risk of a fatal outcome in rural areas include a greater delay in arrival of emergency medical services,²¹ the level of prehospital care received^{22,23} and the unavailability of intensive trauma care in small, rural hospitals.¹⁸ All of these factors have important implications for prevention.

The site of the pedestrian-motor vehicle collisions appears to play a role in causing injury and deserves further investigation. Although the fact that a third of pedestrian injuries occur in crosswalks does, in part, reflect exposure, there is a need to reexamine the effectiveness of crosswalks in preventing pedestrian injury.^{24,25} In crosswalks, the presence of a pedestrian in the street is the signal for a driver to stop; an unseen pedestrian may have a false sense of security by being in a crosswalk. This issue of exposure of injured and noninjured pedestrians in crosswalks needs to be examined further.

The toll due to pedestrian-vehicle collisions can be reduced. Results of this analysis suggest that environmental changes such as improving street lighting and separating children's play areas from garage and driveway (or creating alternative play areas) may have an impact. It is possible that speed bumps or other engineering changes may reduce the number of injuries that occur in crosswalks. In rural areas,

resultant mortality may be decreased by factors influenced by emergency medical systems and emergency services at hospitals. The issue of underreporting of injuries in data routinely used for injury-prevention studies is a cause for concern and lends support to the need for a uniform injury surveillance system. At present, injury researchers must continually be aware of existing gaps in commonly used reporting systems.

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